



(12) **United States Patent**
Liu et al.

(10) **Patent No.:** **US 9,210,311 B2**
(45) **Date of Patent:** **Dec. 8, 2015**

(54) **CAMERA MODULE FOR PORTABLE DEVICE**

USPC 348/294, 335, 340, 373, 374; 396/55,
396/133, 144, 529, 535
See application file for complete search history.

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 173 days.

(21) Appl. No.: **13/710,123**

(22) Filed: **Dec. 10, 2012**

(65) **Prior Publication Data**

US 2013/0265470 A1 Oct. 10, 2013

Related U.S. Application Data

(60) Provisional application No. 61/621,074, filed on Apr. 6, 2012.

(51) **Int. Cl.**
H04N 5/225 (2006.01)
H04N 21/4223 (2011.01)

(52) **U.S. Cl.**
CPC **H04N 5/2257** (2013.01); **H04N 21/4223** (2013.01)

(58) **Field of Classification Search**
CPC H04N 5/2257; H04M 1/0264

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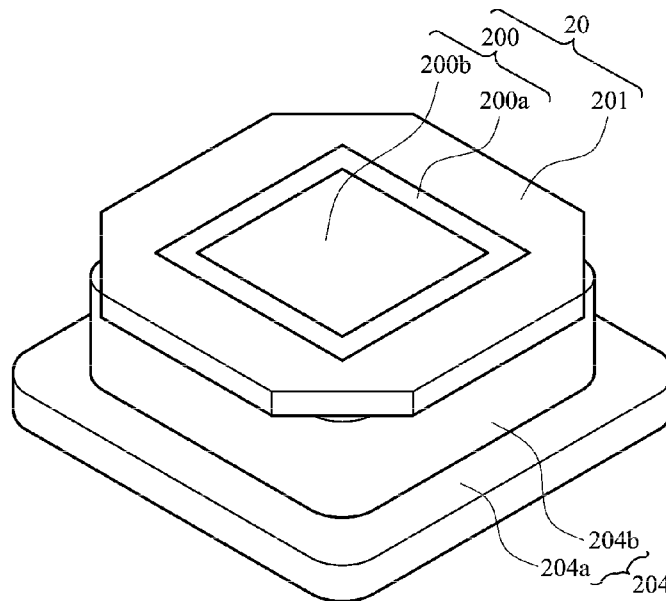
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(57) **ABSTRACT**

A camera module is provided. The camera module includes a camera device and a support ring. The camera device includes a substrate, an image sensor device on the substrate, and a holder for covering the image sensor device, wherein the holder includes a side portion placed around the image sensor device. The support ring is fixed to and laterally extends from the side portion of the holder, and is attached onto a wall portion of the chassis. A portable device with the camera module is also disclosed.

28 Claims, 4 Drawing Sheets



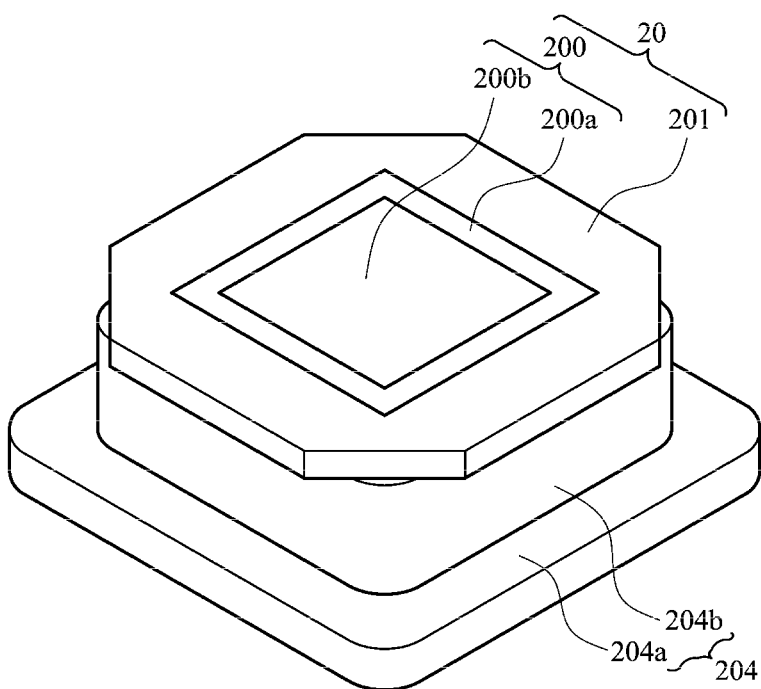


FIG. 1

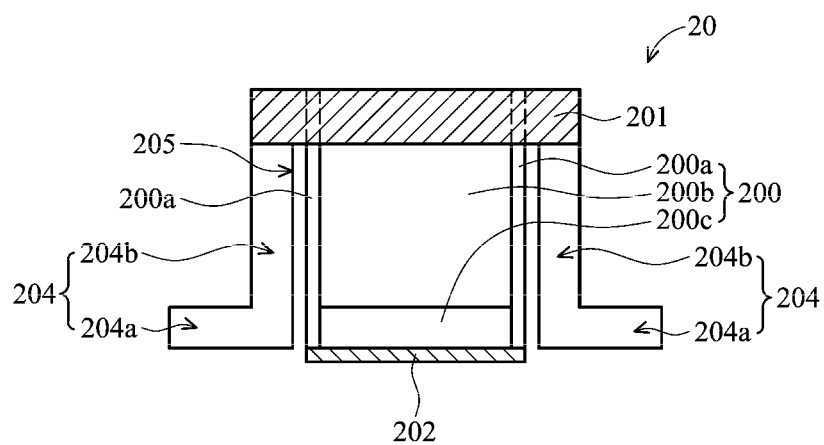


FIG. 2A

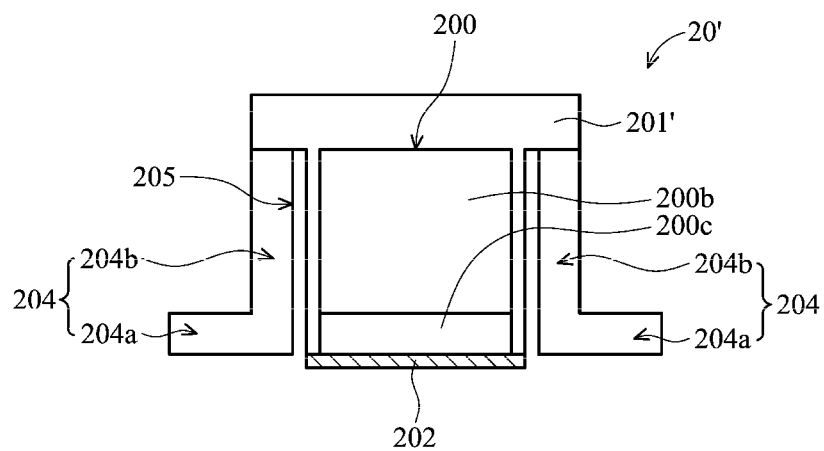
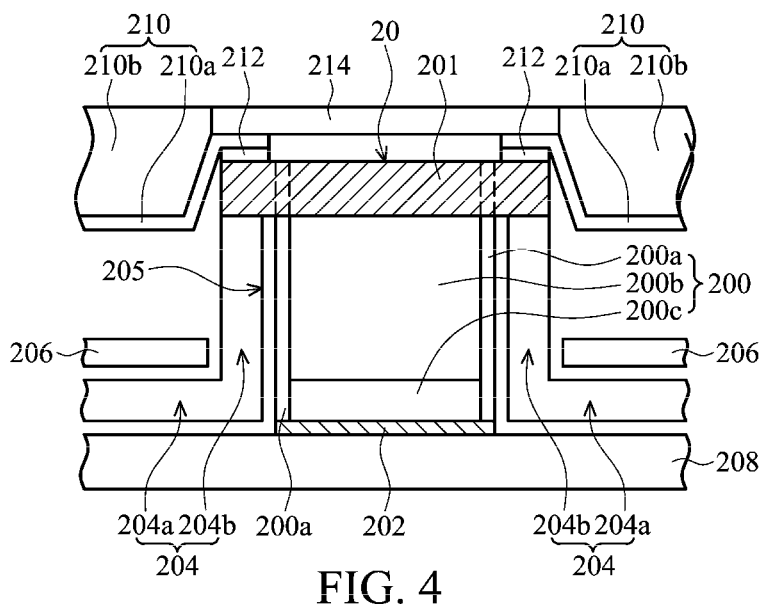
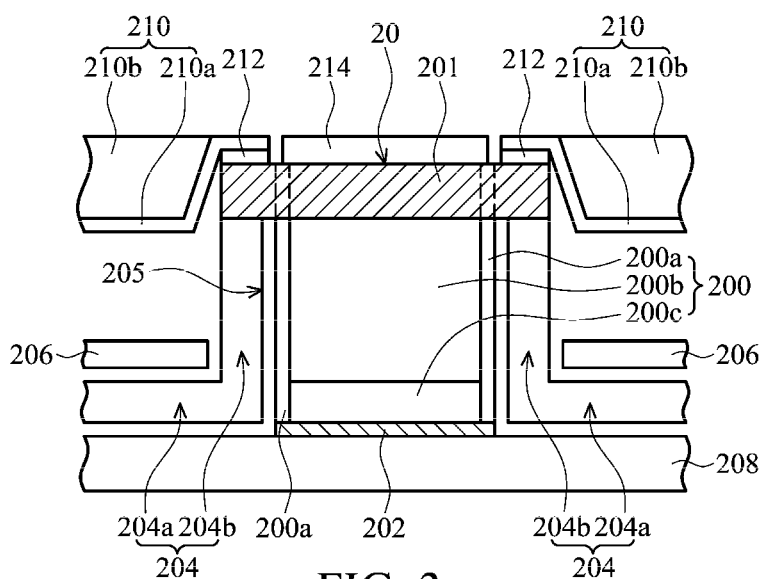


FIG. 2B



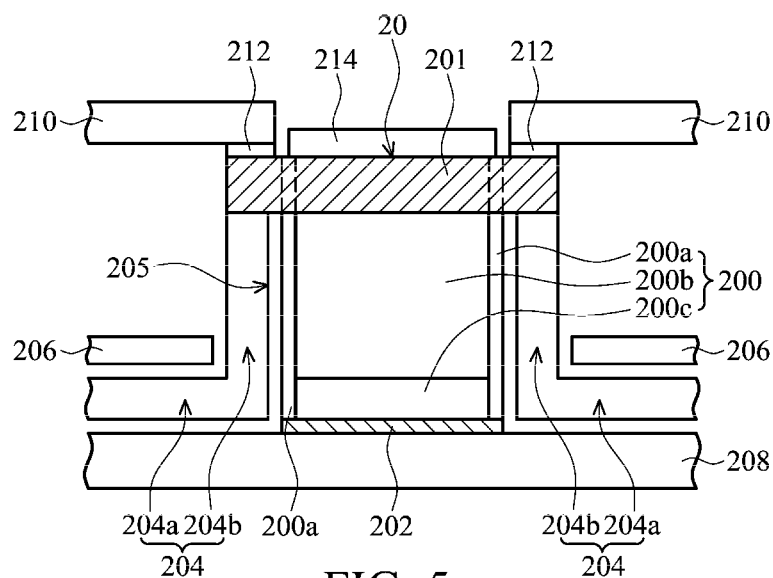


FIG. 5

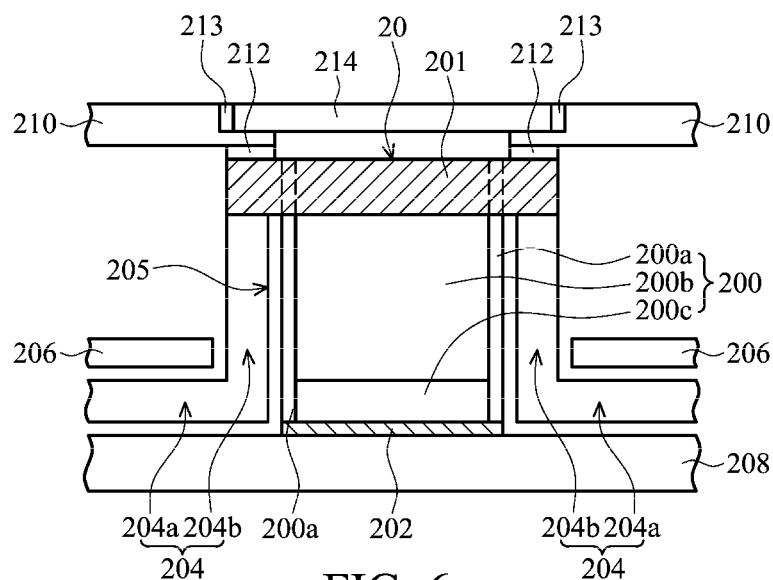


FIG. 6

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CAMERA MODULE FOR PORTABLE
DEVICECROSS REFERENCE TO RELATED
APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61/621074, filed Apr. 6, 2012, which is incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to optical imaging technology, and in particular to a camera module for a mobile phone.

2. Description of the Related Art

Recently, with the development of optical imaging technology, more and more portable devices, such as digital cameras, mobile phones and the like, have become increasingly popular. In particular, mobile communication devices are equipped with camera modules for capturing picture and video, such as camera phones, and are widely used. Nowadays, the camera phone further includes a touch panel display device placed at a front side of the camera phone opposite to the camera module that is placed at a backside of the camera phone.

In a typically camera phone, however, a portion of the camera module may protrude from the housing of the camera phone. Such a protrusion of the camera module is detrimental for providing a camera phone with a flatter and thinner profile. Moreover, such a protrusion of the camera module detracts from the appearance of the camera phone.

Accordingly, there exists a need in the art for development of a novel camera module, capable of mitigating or eliminating the aforementioned problems.

BRIEF SUMMARY OF THE INVENTION

A detailed description is given in the following embodiments with reference to the accompanying drawings. A camera module in a chassis and a portable device are provided. An exemplary embodiment of a camera module comprises a camera device and a support ring. The camera device comprises a substrate, an image sensor device on the substrate, and a holder for covering the image sensor device, wherein the holder includes a side portion placed around the image sensor device. The support ring is fixed to and laterally extends from the side portion of the holder, and is attached onto a wall portion of the chassis.

An exemplary embodiment of a portable device comprises a display module, a housing, a printed circuit board, a chassis and a camera module. The housing has an aperture and covers the display module. The printed circuit board is disposed between the display module and the housing and has a through hole. The chassis comprises a wall portion and a plate portion with a through hole. The wall portion is on the plate portion and along a periphery of the through hole of the plate portion and passes through the through hole of the printed circuit board to create a cavity corresponding to the aperture. The camera module is attached onto the wall portion of the chassis. The camera module comprises a camera device and a support ring. The camera device is disposed in the cavity of the chassis. The support ring is fixed to and laterally extends from a side portion of the camera device.

BRIEF DESCRIPTION OF DRAWINGS

The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

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FIG. 1 is a perspective diagram of an exemplary embodiment of a camera module attached onto a chassis according to the invention;

FIG. 2A is a cross section of the camera module attached onto a chassis shown in FIG. 1;

FIG. 2B is a cross section of another exemplary embodiment of a camera module attached onto a chassis according to the invention; and

FIGS. 3 to 6 are cross sections of various exemplary embodiments of a portable device with a camera module according to the invention.

DETAILED DESCRIPTION OF INVENTION

The following description is of the best-contemplated mode of carrying out the invention. This description is provided for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is best determined by reference to the appended claims.

The following embodiments disclose a camera module and a portable device using the same, which are capable of eliminating the protrusion of the camera module, thereby providing a portable device with a flatter and thinner profile.

Refer to FIGS. 1 and 2A, in which FIG. 1 illustrates a perspective diagram of a camera module 20 attached onto a chassis 204 according to an exemplary embodiment of the present disclosure and FIG. 2A illustrates a cross section of a camera module 20 attached onto a chassis 204 shown in FIG. 1. The camera module 20 comprises a camera device 200, a support ring 201, and a conductive buffer pad 202. Typically, a camera device may comprise a substrate, an image sensor device, a lens set, a flexible printed circuit (FPC) and a holder. The image sensor device, such as a CCD or CMOS, is disposed on the substrate and is used for converting the incident light into an electric signal and outputting the electric signal. The lens set is disposed above the image sensor device for focusing the incident light onto the image sensor device. The FPC is used for receiving the electric signal from the image sensor device and outputting the received electric signal to an external circuit. The holder is used for covering and holding the image sensor device and the overlying lens set. Moreover, the holder may comprise a side portion placed around the image sensor device and the substrate. In order to simplify the diagram, only a holder portion 200a, an image sensor device 200b and a substrate 200c are depicted as representing the camera device 200.

The support ring 201 is fixed to and laterally extends from the side portion of the camera device 200. For example, the support ring 201 is fixed to and laterally extends from an outer circumference of the side portion of the holder 200a, such that the support ring 201 encloses an upper portion of the holder 200a and is in direct contact with the side portion of the holder 200a. As a result, the upper portion of the camera device 200 is also enclosed by the support ring 201. In the embodiment, the support ring 201 may comprise metal or plastic. Moreover, the support ring 201 may comprise a material which is the same as or different from that of the holder 200a of the camera device 200. Additionally, an outer circumference of the support ring 201 may have an octagonal profile, as shown in FIG. 1. However, it is appreciated that the outer circumference of the support ring 201 may have other profiles, such as a circular, triangular, squared, rectangular, pentagonal, hexagonal or polygonal profile.

The conductive buffer pad 202, such as a gasket, is attached onto a lower surface of the substrate 200c of the camera

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device **200** to serve as a portion of grounding path for electromagnetic interference (EMI) protection of the camera device **200**.

In the embodiment, the chassis **204** comprises a plate portion **204a** and a wall portion **204b**. The plate portion **204a** has a through hole. The wall portion **204b** is on the upper surface of the plate portion **204a** and along the periphery of the through hole of the plate portion **204a**, so as to create a cavity **205** in the chassis **204** for placement of the camera device **200**. When the camera device **200** is placed into the cavity **205** of the chassis **204**, the support ring **201** attached onto the upper portion of the camera device **200** forms a flange. The flange is laterally extended from the outer circumference of the holder **200a** of the camera device **200**, to contact an upper surface of the wall portion **204b** of the chassis **204**, such that the camera device **200** attached to the support ring **201** can be supported by the chassis **204**, so as to prevent the camera device **200** from dropping out from the cavity **205** of the chassis **204**. Moreover, a lower portion of the camera device **200** can be further inserted into the through hole of the plate portion **204a** of the chassis **204**. As a result, a protruding amount of the camera module **20** can be reduced or fully eliminated.

Refer to FIG. 2B, which illustrates a cross section of a camera module **20'** attached onto a chassis **204** according to another exemplary embodiment of the present disclosure. Elements in FIG. 2B that are the same as those in FIG. 2A are labeled with the same reference numbers as in FIG. 2A and are not described again for brevity. In the embodiment, the camera module **20'** has a structure similar to the camera module **20** shown in FIG. 2A except that the support ring is integrally formed with the holder of the camera device **200** and is labeled with **201'**.

FIGS. 3 to 6 illustrate cross sections of various exemplary embodiments of a portable device with a camera module according to the present disclosure. Elements in FIGS. 3 to 6 that are the same as those in FIG. 2A are labeled with the same reference numbers as in FIG. 2A and are not described again for brevity. Referring to FIG. 3, a portable device, such as a mobile phone, comprises a display module **208**, a housing **210**, a printed circuit board (PCB) **206**, a chassis **204**, and a camera module **20**. The display module **208** may comprise, for example, a liquid crystal display (LCD) device, an organic light-emitting display (OLED) device, an MEMS display module, or an electrophoretic display (EPD) device. In some embodiments, the display module **208** may further comprise a touch sensing module (which is also referred to as a touch window) integrated into the display module to form a touch panel display.

The housing **210** has an aperture and covers the display module **208**. In the embodiment, the housing **210** comprises a multilayer structure. For example, the housing **210** may comprise a first layer **210a** and a second layer **210b** on the first layer **210a**. In one embodiment, the first layer **210a** may comprise metal and the second layer **210b** may comprise plastic.

The PCB **206** is disposed between a non-viewing side of the display module **208** and the housing **210** and may be fixed to the housing **210**. The PCB **206** has a through hole to expose a region of the display module **208** where a camera module **20** is mounted thereon.

The chassis **204** comprises a plate portion **204a** with a through hole and a wall portion **204b**, wherein the plate portion **204a** of the chassis **204** is interposed between the PCB **206** and the display module **208** and is fixed to the housing **210** or the PCB **206**. Moreover, the wall portion **204b** is on the upper surface of the plate portion **204a** and along the

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periphery of the through hole of the plate portion **204a** and passes through the through hole of the PCB **206**, so as to create a cavity **205** in the chassis **204** and corresponding to the aperture of the housing **210**. The chassis **204** may be composed of metal, such as aluminum, copper, an alloy thereof, or combinations thereof, and the like.

The camera module **20** is attached onto the wall portion of the **204b** of the chassis **204**. Moreover, the camera module **20** has a lower surface attached onto the display module **208** by the conductive buffer pad **202**. The camera device **200** of the camera module **20** is disposed in the cavity **205** of the chassis **204**. Moreover, the support ring **201** of the camera module **20** is fixed to and laterally extends from the side portion of the camera device **200**, such that the support ring **201** of the camera module **20** encloses the upper portion of the camera device **200** and is laterally extended from an outer circumference of the camera device **200** to an upper surface of the wall portion **204b** of the chassis **204**. The camera module **20** is electrically connected to the PCB **206** by the FPC (not shown) of the camera device **2000**. Moreover, the conductive buffer pad **202** is electrically connected to the grounding pad (not shown) of the display module **208**, thereby accomplishing EMI protection of the camera module **20**.

In one embodiment, the wall portion **204b** has an open ring profile as viewed from a top-view perspective, such that an FPC (not shown) of the camera device **200** can be laterally extended to outside of the chassis **204** from the cavity **205**. This is convenient for electrically connecting the camera device **200** to an external circuit (not shown) via the FPC. In another embodiment, the wall portion **204b** has a closed ring profile as viewed from a top-view perspective. In this case, the wall portion **204b** further comprises a through hole, such that the FPC of the camera device **200** can be laterally extended to outside of the chassis **204** from the cavity **205**.

An optional protective lens **214** may be in the aperture of the housing **210** to cover the camera module **20**. For example, the protective lens **214** may be attached onto the support ring **201** of the camera module **20** by an adhesive layer (not shown), such as a tape, to cover the camera device **200**. Moreover, a sponge **212**, which has a ring profile as viewed from a top-view perspective, may be optionally interposed between the housing **210** and the support ring **201** of the camera module **20** to serve as a shock absorber. Since the protruding amount of the camera module **20** can be reduced or fully eliminated, the upper surface of the protective lens **214** can be substantially level with or lower than the outer surface of the housing **210**.

Referring to FIG. 4, the portable device has a structure similar to the structure shown in FIG. 3 except for the position of the protective lens **214**. In the embodiment, the protective lens **214** is not in direct contact with the support ring **201** of the camera module **20**, but is disposed on a surrounding portion of the housing **210**, which circumscribes the aperture of the housing **210**. For example, the protective lens **214** is disposed on a portion of the first layer **210a** of the housing **210** and is enclosed by the second layer **210b** of the housing **210**. In the embodiment, the upper surface of the protective lens **214** also can be substantially level with or lower than the outer surface of the housing **210**.

Referring to FIG. 5, the portable device has a structure similar to the structure shown in FIG. 3 except for the structure of the housing **210**. In the embodiment, the housing **210** has a single layer structure and may comprise metal or plastic. In the embodiment, the upper surface of the protective lens **214** can also be substantially level with or lower than the outer surface of the housing **210**.

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Referring to FIG. 6, the portable device has a structure similar to the structure shown in FIG. 5 except for the position of the protective lens 214. In the embodiment, the protective lens 214 is not in direct contact with the support ring 201 of the camera module 20, but is disposed on a surrounding portion of the housing 210, which circumscribes the aperture of the housing 210. Moreover, a camera ring 213 may be optionally interposed between the protective lens 214 and the housing 210. In the embodiment, the upper surface of the protective lens 214 also can be substantially level with or lower than the outer surface of the housing 210.

It is noted that although the portable devices shown in FIGS. 3 to 6 are equipped with the camera module 20 shown in FIG. 2A, it is appreciated that these portable devices may be equipped with the camera module 20' shown in FIG. 2B to obtain the same or similar advantages achieved in the embodiments of FIGS. 3 to 6.

According to the foregoing embodiments, since a protruding amount of the camera module 20 can be reduced or fully eliminated by partially inserting the camera device 200 into the through hole of the plate portion 204a of the chassis 204, a mobile phone with a flatter and thinner profile can be accomplished and the appearance thereof can be embellished. Moreover, since the conductive buffer pad 202 is directly electrically connected to the display module 208, the grounding path can be shortened to improve EMI protection performance.

While the invention has been described by way of example and in terms of preferred embodiment, it is to be understood that the invention is not limited thereto. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. A portable device, comprising:
 - a display module;
 - a housing having an aperture and covering the display module;
 - a printed circuit board disposed between the display module and the housing and having a through hole;
 - a chassis comprising a wall portion and a plate portion with a through hole,
 - wherein the wall portion is on the plate portion and along a periphery of the through hole of the plate portion and passes through the through hole of the printed circuit board to create a cavity corresponding to the aperture;
 - a camera module attached onto the wall portion of the chassis, wherein the camera module comprises:
 - a camera device disposed in the cavity of the chassis; and
 - a support ring undetachably and directly fixed to and extending radially outward from a side portion of the camera device in a lateral direction;
 - a protective lens in the aperture of the housing to cover the camera module; and
 - a sponge interposed between the housing and the support ring of the camera module.
2. The portable device of claim 1, wherein a lower surface of the camera module is attached onto the display module.
3. The portable device of claim 1, wherein the support ring encloses an upper portion of the camera device, and the support ring is laterally extended from an outer circumference of the camera device to an upper surface of the wall portion of the chassis.

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4. The portable device of claim 1, wherein the plate portion of the chassis is interposed between the printed circuit board and the display module and fixed to the housing or the printed circuit board.

5. The portable device of claim 1, wherein the printed circuit board is fixed to the housing.

6. The portable device of claim 1, wherein the protective lens is attached onto the support ring of the camera module.

7. The portable device of claim 1, wherein the protective lens is disposed on a surrounding portion of the housing, which circumscribes the aperture of the housing.

8. The portable device of claim 7, wherein the housing comprises a first layer and a second layer thereon, such that the protective lens is disposed on a portion of the first layer and enclosed by the second layer.

9. The portable device of claim 8, wherein the first layer comprises metal and the second layer comprise plastic.

10. The portable device of claim 1, wherein an upper surface of the protective lens is substantially level with or lower than an outer surface of the housing.

11. The portable device of claim 1, further comprising a camera ring interposed between the protective lens and the housing.

12. The portable device of claim 1, wherein the camera module further comprises a conductive buffer pad attached between the display module and a lower surface of the camera device.

13. The portable device of claim 12, wherein the conductive buffer pad is electrically connected to a grounding pad of the display module.

14. The portable device of claim 1, wherein the camera device comprises a holder in direct contact with the support ring.

15. The portable device of claim 1, wherein the camera device comprises a holder integrally formed with the support ring.

16. The portable device of claim 1, wherein the wall portion of the chassis has an open ring profile as viewed from a top-view perspective.

17. The portable device of claim 1, wherein the wall portion of the chassis has a closed ring profile as viewed from a top-view perspective and has a through hole.

18. The portable device of claim 1, wherein a lower portion of the camera device is inserted into the through hole of the plate portion of the chassis.

19. A portable device, comprising:
 - a display module;
 - a housing having an aperture and covering the display module;
 - a printed circuit board disposed between the display module and the housing and having a through hole;
 - a chassis comprising a wall portion and a plate portion with a through hole, wherein the wall portion is on the plate portion and along a periphery of the through hole of the plate portion and passes through the through hole of the printed circuit board to create a cavity corresponding to the aperture; and
 - a camera module attached onto the wall portion of the chassis, wherein the camera module comprises:
 - a camera device disposed in the cavity of the chassis, wherein the camera module further comprises a conductive buffer pad attached between the display module and a lower surface of the camera device, wherein the conductive buffer pad is electrically connected to a grounding pad of the display module; and

a support ring undetachably and directly fixed to and extending radially outward from a side portion of the camera device in a lateral direction.

20. The portable device of claim 19, wherein a lower surface of the camera module is attached onto the display module. 5

21. The portable device of claim 19, wherein the support ring encloses an upper portion of the camera device, and the support ring is laterally extended from an outer circumference of the camera device to an upper surface of the wall portion of the chassis. 10

22. The portable device of claim 19, wherein the plate portion of the chassis is interposed between the printed circuit board and the display module and fixed to the housing or the printed circuit board. 15

23. The portable device of claim 19, wherein the printed circuit board is fixed to the housing.

24. The portable device of claim 19, wherein the camera device comprises a holder in direct contact with the support ring. 20

25. The portable device of claim 19, wherein the camera device comprises a holder integrally formed with the support ring.

26. The portable device of claim 19, wherein the wall portion of the chassis has an open ring profile as viewed from a top-view perspective. 25

27. The portable device of claim 19, wherein the wall portion of the chassis has a closed ring profile as viewed from a top-view perspective and has a through hole.

28. The portable device of claim 19, wherein a lower portion of the camera device is inserted into the through hole of the plate portion of the chassis. 30

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